Factors Affecting Colored Dissolved Organic Matter in Aquatic Environments of the Southeastern United States

Richard Zepp
Sr. Research Scientist
U.S. EPA Office of Research and Development (ORD)/National Exposure Research Laboratory (NERL)/Ecosystems Research Division (ERD)
(706) 355-8117
zepp.richard@epa.gov

Authors: Richard Zepp[1], Christopher Shank[2], Mary Ann Moran[3], Wade Sheldon[3]
[1]U.S. EPA ORD/NERL/ERD
[2]U.S. EPA ORD/NERL/ERD, National Research Council Associate
[3]Department of Marine Sciences, University of Georgia, Athens, GA
Keywords: colored dissolved organic matter, microbial degradation, photoreaction, sorption, aquatic PM

The sunlight-absorbing (colored) component of dissolved organic matter (CDOM) in aquatic environments is widely distributed in freshwaters and coastal region, where it influences the fate and transport of toxic organic substances and biologically important metals such as mercury, iron, and copper. CDOM also has significant effects on underwater visibility and ultraviolet radiation, and it is an important component of remotely sensed ocean color. In this research, we have examined two key factors, microbial degradation and sorption, that affect the loss of CDOM in rivers, estuaries, and coastal shelf regions of the Southeastern United States. Sorption involves the sticking of CDOM to particles that are in the water. CDOM is generally resistant to microbial decomposition, but this research has discovered an important pathway for its loss from aquatic environments that involves “photochemically stimulated” microbial degradation. We discovered that absorption of sunlight by CDOM results in its breakdown to low-molecular-weight substances that are readily degraded by microorganisms. Using measured efficiencies for the effects of sunlight on microbial decomposition of CDOM, we have developed procedures for forecasting its degradation as a function of time, location, and depth in coastal rivers and shelf regions of the Southeast. CDOM also is lost by sorption to settling aquatic particulate matter (PM). We found that CDOM sorption to aquatic PM is a reversible process that can be quantified by use of partition coefficients. The research demonstrated that sorption is a major pathway for loss of CDOM in turbid waters, such as coastal estuaries, and that this loss is accelerated when ocean water mixes with freshwater. Measurements of changes in CDOM fluorescence showed that photo-stimulated microbial degradation coupled with sorption of CDOM onto aquatic PM can result in substantial losses of CDOM within estuaries of the coastal Southeastern United States.